इंटरनेट मानक

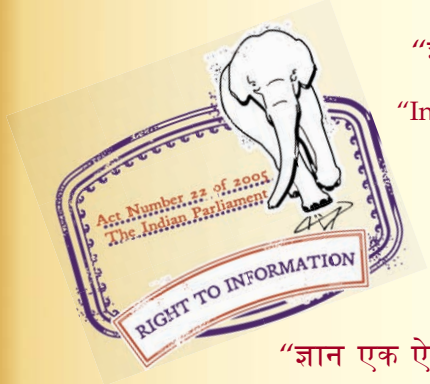
Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

"जानने का अधिकार, जीने का अधिकार"
Mazdoor Kisan Shakti Sangathan
"The Right to Information, The Right to Live"

"पुराने को छोड नये के तरफ"
Jawaharlal Nehru
"Step Out From the Old to the New"

IS 8623-2 (1993): Low-voltage Switchgear and Control gear Assemblies, Part 2: Particular Requirements for Busbar Trunking Systems (Busway) [ETD 7: Low Voltage Switchgear and Controlgear]



"ज्ञान से एक नये भारत का निर्माण"
Satyanarayan Gangaram Pitroda
"Invent a New India Using Knowledge"

"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

BLANK PAGE

IS 8623 (Part 2) : 1993
IEC Pub 439-2 (1987)
(Reaffirmed 1998)

भारतीय मानक

अल्प वोल्टता स्विच और नियंत्रण गियर समुच्चयों की विशिष्टि

भाग 2 "बसबार" धातु-आवरण तंत्र (बसवेज) की विशेष अपेक्षाएं

(पहला पुनरीक्षण)

Indian Standard

SPECIFICATION FOR LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR ASSEMBLIES

PART 2 PARTICULAR REQUIREMENTS FOR BUSBAR TRUNKING SYSTEMS (BUSWAYS)

(First Revision)

Second Reprint APRIL 2000

UDC 621.316.351:621.3.02/.3

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

March 1993

Price Group 7

NATIONAL FOREWORD

This Indian Standard (Part 2) which is identical with IEC Pub 439-2 (1987) 'Low voltage switchgear and controlgear assemblies — Part 2 : Particular requirements for busbar trunking systems (busways)' covering specific requirements for bus-bar trunking systems. Busbar trunking systems (busways) shall comply with all requirements of Part 1 of this standard; if not otherwise indicated hereinafter and shall also comply with particular requirements contained in this part.

The text of the IEC standard has been considered and approved by ETD 07, Low Voltage Switchgear and Controlgear Sectional Committee of BIS, as suitable for publication as Indian Standard, as the first revision of IS 8623 (Part 2).

CROSS REFERENCE

In this Indian Standard the following International Standards are referred to. Read in their respective place the following:

International Standard (IEC)	*Indian Standard*
430-1 (1985)	Part 1 of this standard

As regards IEC Pub 570 (1985) referred to in this standard, the Technical Committee responsible for the preparation of this standard has decided that they are acceptable for use in conjunction with this standard.

IEC 439-2

1987

AMENDMENT 1

1991-09

Amendment 1

Low-voltage switchgear and controlgear assemblies

Part 2:
Particular requirements for busbar trunking systems (busways)

Page 3

4 Electrical characteristics of assemblies

4.10 *Resistance and reactance values*

a) Replace the existing title by the following:

Resistance, reactance and impedance values

b) Add at the end of this subclause:

For busbar trunking systems intended to be protected against indirect contact by automatic disconnection of supply by means of overcurrent protective devices the manufacturer shall also state the following value:

Z_F = impedance per metre length of the loop including the protective circuit and the phase which gives the highest impedance.

This impedance shall be measured with a current equal to the rated current under the conditions specified in subclause 8.2.8.

NOTES

1 The impedance based on measurement at rated current is sufficient in most cases. There may be cases, however, where it is necessary to utilize the fact that the impedance is lower at higher currents. Information about the relationship between current and impedance can be provided by the manufacturer.

2 For busbar trunking systems which represent only a part of the total fault loop impedance it is more appropriate to state the resistance and reactance of the busbar loop separately instead of the impedance.

Calculate the impedance Z_F, the alternating current resistance R_F, and the reactance X_F, in ohms per metre, between phase and PE/PEN conductor, as follows:

$$Z_F = \frac{V}{I \cdot l}$$

$$R_F = \frac{P}{I^2 \cdot l}$$

$$X_F = (Z_F^2 - R_F^2)^{1/2}$$

Indian Standard

SPECIFICATION FOR LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR ASSEMBLIES

PART 2 PARTICULAR REQUIREMENTS FOR BUSBAR TRUNKING SYSTEMS (BUSWAYS)

(First Revision)

General

1.1 *Scope*

Add the following paragraph:

This standard also applies to busbar trunking systems intended to supply luminaires through tap-off units but does not apply to supply track systems in accordance with IEC Publication 570.

2. Definitions

2.1.1.2 *Partially type-tested LV switchgear and controlgear assemblies (PTTA)*

Not applicable.

2.3.4 *Busbar trunking system (busway)*

A type-tested assembly in the form of a conductor system comprising busbars which are spaced and supported by insulating material in a duct, trough or similar enclosure.

The assembly may consist of units such as:

- busbar trunking units with or without tap-off facilities,
- phase transposition, expansion, flexible, feeder and adapter units,
- tap-off units.

Note.- The term "busbar" does not prejudge the geometrical shape, size or dimensions of the conductor.

Add the following definitions:

2.3.5 *Busbar trunking unit*

A unit of a busbar trunking system complete with busbars, their supports and insulation, external enclosure and any fixing and connecting means to other units, with or without tap-off facilities.

Note.- Trunking units may have different geometrical shapes such as straight length, elbow, tee or cross.

2.3.6 *Busbar trunking unit with tap-off facilities*

A busbar trunking unit designed to enable tap-off units to be installed at one or more points as predetermined by the manufacturer.

The connection of tap-off units to the busbar trunking unit may or may not require the busbar system to be disconnected from the supply.

2.3.7 *Busbar trunking unit with trolley-type tap-off facilities*

A busbar trunking unit designed to permit the use of roller- or brush-type tap-off units.

2.3.8 *Busbar trunking adapter unit*

A busbar trunking unit intended to connect two units of the same system but of different type or of different rated current.

2.3.9 *Busbar trunking expansion unit*

A busbar trunking unit intended to permit a certain movement in the axial direction of the busbar trunking system, e.g. thermal expansion.

2.3.10 *Busbar phase transposition unit*

A busbar trunking unit intended to change the relative positions of the phase conductors in order to balance the inductive reactances or to transpose the phases (such as L1-L2-L3-N to N-L3-L2-L1).

2.3.11 *Flexible busbar trunking unit*

A busbar trunking unit having conductors and enclosures designed to be bent during installation.

2.3.12 *Busbar trunking feeder unit*

A busbar trunking unit serving as any incoming unit. The connection of the feeder unit to the supply may or may not require the supply to be disconnected.

2.3.13 *Tap-off unit*

An outgoing unit for tapping-off power from the busbar trunking unit with tap-off facilities (see Sub-clause 2.3.6), such as rollers, brushes or plug-in devices.

4. Electrical characteristics of assemblies

Add Sub-clause 4.10 as follows:

4.10 *Resistance and reactance values*

The manufacturer shall state in the manner described in Clause 5 the following mean values of the different phases, if any:

R = the mean ohmic resistance of the trunking system per metre length per phase:

- for all busbar trunking systems irrespective of rated current: resistance R_{20} at a conductor temperature of +20 °C;

- further, for busbar trunking systems with a rated current greater than 630 A: resistance R_t when thermal equilibrium is reached at an ambient temperature of +20 °C for the rated current.

X = the mean reactance of the trunking system per metre length per phase at rated frequency.

The values of R and X may be determined by direct measurement or by calculations from measurements (see Appendix F).

5. Information to be given regarding the assembly

5.1 *Nameplates*

Add Item r) as follows

r) mean resistance and reactance values

7. Design and construction

7.1.1 *General*

Add the following text.

Busbar trunking systems shall be designed as type-tested low-voltage switchgear and controlgear assemblies (TTA).

According to the manufacturer's indications, busbar trunking systems are intended to withstand:

- either normal mechanical loads (see Sub-clause 7.1.1.1),
- or heavy mechanical loads (see Sub-clause 7.1.1.2),
- or special mechanical loads (see Sub-clause 7.1.1.3).

7.1.1.1 *Normal mechanical loads*

For busbar trunking systems, normal mechanical loads include, in addition to their own weight, mechanical loads imposed by the feeder and tap-off units.

Notes 1.- The necessary mechanical rigidity may be obtained by the choice of material, its thickness, its shape, and/or by the number and position of fixing points as indicated by the manufacturer.

2.- Feeder units supported by their own separate fixings shall not be included in normal mechanical loads.

7.1.1.2 *Heavy mechanical loads*

For busbar trunking systems, heavy mechanical loads include, in addition to the normal mechanical loads, additional loads such as the weight of a person.

Notes 1.- The necessary mechanical rigidity may be obtained by the choice of material, its thickness, its shape, and/or by the number and position of fixing points as indicated by the manufacturer.

2.- The statement does not imply that the busbar trunking system may be used as a walkway.

7.1.1.3 *Special mechanical loads*

The ability of busbar trunking systems to withstand other additional loads, such as lighting apparatus, additional cables, ladder supports, etc., shall be subject to agreement between manufacturer and user.

7.1.1.4 *Insulating materials*

Self-extinguishing properties of insulating materials are under consideration.

Add Sub-clause 7.1.4 as follows:

7.1.4 *Requirements for the correct connection of tap-off units*

When a busbar trunking system with predetermined tap-off facilities has a protective conductor or a neutral conductor or both, the design shall be such that, for reasons of safety, incorrect assembly of any part of the system or connection of the tap-off units is prevented.

In the case of d.c. or single-phase a.c. the order of polarities shall be maintained throughout the entire length of the system.

In case of three-phase a.c., the phase sequence shall be maintained along the entire length of the system.

Table III: Temperature-rise limits

Replace footnote 4) by the following:

Unless otherwise specified in the case of external surfaces of enclosures of busbar trunking systems which are accessible but do not need to be touched during normal operation, an increase in the temperature-rise limits by 25 K is permissible for metal surfaces and by 15 K for insulating surfaces.

7.6.2.1 *Accessibility*

First paragraph not applicable.

8. Test specifications

Replace the existing text by the following:

8.1.1 *Type tests (see Sub-clause 8.2)*

Type tests are intended to verify compliance with the requirements laid down in this standard for a given type of busbar trunking system.

Type tests shall be carried out on a sample of such a busbar trunking system or on such parts of busbar trunking systems manufactured to the same or a similar design.

They shall be carried out on the initiative of the manufacturer.

Type tests include:

a) verification of temperature-rise limits (Sub-clause 8.2.1, Publication 439-1),

b) verification of the dielectric properties (Sub-clause 8.2.2, Publication 439-1),

c) verification of the short-circuit strength (Sub-clause 8.2.3, Publication 439-1),

d) verification of the continuity of the protective circuit (Sub-clause 8.2.4, Publication 439-1),

e) verification of clearances and creepage distances (Sub-clause 8.2.5, Publication 439-1),

f) verification of mechanical operation (Sub-clause 8.2.6, Publication 439-1),

g) verification of the degree of protection (Sub-clause 8.2.7, Publication 439-1),

h) verification of resistance and reactance (Sub-clause 8.2.8 of this publication),

l) verification of structural strength (Sub-clause 8.2.9 of this publication),

k) verification of the endurance of trunking systems with trolley type tap-off facilities (Sub-clause 8.2.10 of this publication).

These tests may be carried out in any order and/or on different samples of the same type.

If modifications are made to the components of the assembly, new type tests have to be carried out only in so far as such modifications are likely to adversely affect the results of these tests.

Note - Reference should also be made to the additions to Sub-clauses 8.2.1 and 8.2.3 given in this part of the publication.

8.2 *Type tests*

8.2.1 *Verification of temperature-rise limits*

8.2.1.2 *Arrangement of the busbar trunking system*

The busbar trunking system to be tested shall be arranged as in normal use, with all covers, etc., in place.

The current rating of a busbar trunking system is affected by the mounting arrangement. Therefore the temperature rise test has to be performed with the rated current appropriate to the mounting arrangement(s) stated by the manufacturer. If only one test is performed, the most unfavourable mounting arrangement shall be used.

8.2.1.3 *Temperature-rise tests*

A test shall be performed over a total length of at least 6 m including at least one joint.

The test currents shall be substantially equal in the live conductors.

Any unintentional circulation of air in the section under test shall be prevented, e.g. by closing the ends.

Another temperature-rise test shall be made on each size of tap-off unit designed to be connected to the busbar trunking system. For this test, the tap-off unit shall carry its rated current and the busbar trunking system shall be supplied with its rated current.

The size and the disposition of external conductors used for the test shall be part of the test report.

The test shall be made for a sufficient time for the temperature rise to reach a constant value (but not exceeding 8 h). In practice, this condition is reached when the variation does not exceed 1 K per hour.

Note.- In practice, to shorten the test the current may be increased during the first part of the test, it being reduced to the specified test current afterwards.

In the absence of detailed information as to the service conditions, the cross-section of the external conductors shall be as follows: (see Publication 439-1).

8.2.3 *Verification of the short-circuit strength*

8.2.3.2.1 *Test arrangement*

The busbar trunking system shall be set up as in normal use. The type test shall be carried out on an assembly comprising at least one busbar trunking feeder unit connected to the appropriate number of straight trunking units to obtain a length of not more than 6 m.

Other types of trunking units and tap-off units not included in the above test shall be tested individually.

8.2.3.2.5 *Results to be obtained*

After the test, the conductors shall not show any undue deformation. Slight deformation of busbars is acceptable provided that the clearances and creepage distances specified in Sub-clause 7.1.2 are still complied with and that the deformation does not interfere with the proper connection of tap-off units. Also, the insulation of the conductors and the supporting insulating parts shall not show any significant signs of deterioration, that is, the essential characteristics of the insulation remain such that the mechanical and dielectric properties of the equipment satisfy the requirements of this standard.

The detection device shall not indicate a fault current.

There shall be no loosening of parts used for the connection of conductors and conductors shall not separate from the outgoing terminals.

The effectiveness of the protective conductors ensuring protection against electric shock in case of a fault shall not be impaired.

Deformation of the enclosure is permissible to the extent to which the degree of protection is not impaired and the clearances are not reduced to values which are less than those specified.

Any distortion of the busbar circuit or the frame of the assembly which impairs normal insertion of withdrawable or removable units shall be deemed a failure.

In case of doubt, it shall be checked that the apparatus incorporated in the assembly is in a condition as prescribed in the relevant specifications.

Add Sub-clauses as follows:

8.2.8 *Verification of resistance and reactance*

The mean values of resistance and reactance (see Sub-clause 4.10 of this publication) are determined on a test specimen having a total length of at least 6 m including at least one joint.

The method of determination shall be chosen by the manufacturer. An example of calculation from measurements is given in Appendix F.

8.2.9 *Verification of structural strength*

According to the mechanical loads indicated by the manufacturer, the verification of the structural strength of busbar trunking systems intended for horizontal installation shall be made in accordance with the following test procedures:

- for normal mechanical loads: see Sub-clause 8.2.9.1,
- for heavy mechanical loads: see Sub-clause 8.2.9.2,
- for special mechanical loads: see Sub-clause 8.2.9.3.

8.2.9.1 *Verification of the structural strength with normal mechanical loads*

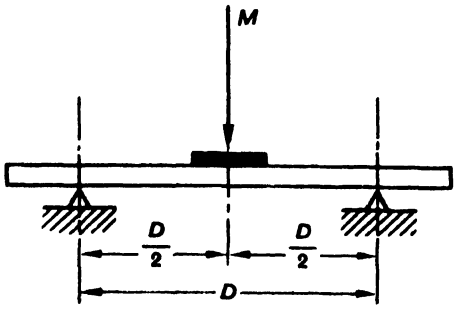
These tests verify the structural strength with normal mechanical loads according to Sub-clause 7.1.1.1.

8.2.9.1.1 The first test shall be made on one straight trunking unit, which is supported as in normal use at two positions spaced at the distance *D*. This distance *D* shall be the maximum distance between supports specified by the manufacturer.

Note.- The location and form of the supports are to be specified by the manufacturer.

A mass *M* shall be placed without dynamic loading on a square rigid piece with sides equal to the width of the busbar trunking system, at the midpoint between the supports on top of the enclosure. The mass *M* shall be equal to the mass *m* of that part of the trunking unit which is between the supports plus an additional mass m_L equal to the maximum load imposed by the feeder and tap-off units specified by the manufacturer to be connected to the length *D*.

The duration of the test shall be 5 min.



$M = m + m_L$

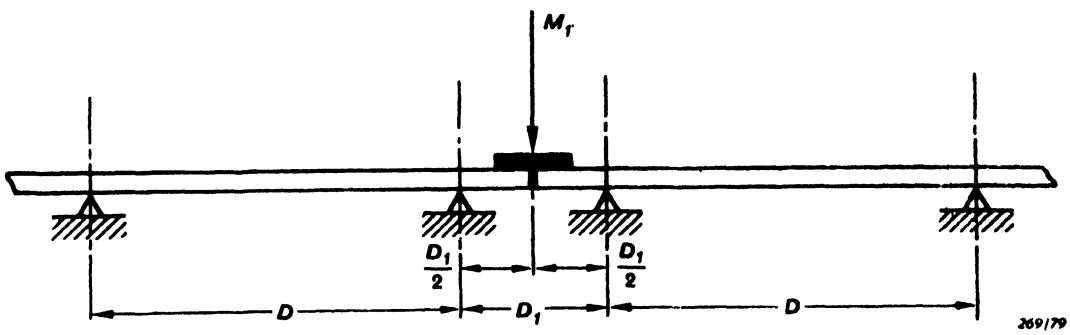
m = mass of the trunking unit between supports

m_L = mass of the feeder and tap-off units

8.2.9.1.2 A second test shall be made on two straight trunking units joined together and supported as in normal use at the minimum number of positions at the maximum distances D and D_1. The distance D is that specified in Sub-clause 8.2.9.1.1; the distance D_1 is the maximum distance between supports adjacent to a joint as specified by the manufacturer. The joint shall be placed midway between the supports.

A mass M_1 shall be placed without dynamic loading on top of the enclosure at the joint on a square rigid piece with sides equal to the width of the busbar trunking system. The mass M_1 shall be equal to the mass m_1 of those parts of the trunking units, including the joint, between the supports located at distance D_1 plus an additional mass m_{L1} equal to the maximum load imposed by the feeder and tap-off units specified by the manufacturer to be connected to the length D_1.

The duration of the test shall be 5 min.



$M_1 = m_1 + m_{L1}$

m_1 = mass of the trunking units including joint between supports at distance D_1

m_{L1} = mass of the feeder and tap-off units

8.2.9.2 *Verification of the structural strength with heavy mechanical loads*

These tests verify the structural strength with heavy mechanical loads according to Sub-clause 7.1.1.2.

8.2.9.2.1 The test described in Sub-clause 8.2.9.1.1 shall be performed with the mass

$$M = m + m_L + 90 \text{ kg}$$

8.2.9.2.2 The test described in Sub-clause 8.2.9.1.2 shall be performed with the mass

$$M_1 = m_1 + m_{L1} + 90 \text{ kg}$$

8.2.9.3 *Verification of the structural strength with special mechanical loads*

The tests verifying the structural strength with special mechanical loads (Sub-clause 7.1.1.3) shall be the subject of an agreement between manufacturer and user.

8.2.9.4 *Results to be obtained*

During and after these tests, neither the trunking units nor the joint or parts of them shall break; in addition, there shall be no deformation of the enclosure which would compromise the degree of protection or reduce the clearances and creepage distances to values which are less than those specified (see Sub-clause 7.1.2 of IEC Publication 439-1). After the test, there shall be no appreciable permanent deformation which, for example, would be liable to impair the correct insertion of incoming and outgoing units.

During and after these tests the protective circuit shall remain functional.

After each of the tests according to Sub-clause 8.2.9.1, 8.2.9.2 or 8.2.9.3, the test assemblies shall withstand the dielectric test according to Sub-clause 8.2.2 of IEC Publication 439-1.

8.2.10 *Verification of the endurance of trunking systems with trolley type tap-off facilities*

With the sliding contacts carrying their rated current at rated voltage, it shall be possible to carry out successfully 10 000 cycles of to and from movements along the conductors of the trunking system.

In the case of a.c., the power factor of the load shall be from 0.75 to 0.8.

The speed of the trolley carrying the sliding contacts and the distance through which it moves shall be determined by the operating conditions for which it is designed. If the trolley is intended to support a tool or other mechanical load, an equivalent weight shall be suspended from it during the test.

After completion of the test, there shall be no mechanical or electrical defect, whether by undue pitting, burning or welding of the contacts.

Add an Appendix F as follows:

APPENDIX F

EXAMPLE OF DETERMINATION OF *R* AND *X* BY CALCULATION FROM MEASUREMENTS FOR A THREE-PHASE A.C. BUSBAR TRUNKING SYSTEM

The following measurements shall be recorded from the test data obtained during the temperature-rise test:

V = the average r.m.s. line-to-line voltage drop in volts

$$V = \frac{V_{12} + V_{23} + V_{31}}{3}$$

I = the average r.m.s. current in amperes

$$I = \frac{I_1 + I_2 + I_3}{3}$$

P = the total three-phase power in watts

L = the length in metres from the voltmeter leads connected at the input end to the point where the busbars are connected together at the output end.

Calculate the impedance Z, the alternating current resistance R, and the reactance X, in ohms per metre on line-to-neutral basis, as follows:

$$Z = \frac{V}{\sqrt{3}\, IL}$$

$$R = \frac{P}{3\, I^2 L}$$

$$X = (Z^2 - R^2)^{1/2}$$

Note.- A more elaborate method of calculation is under consideration.

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act*, 1986 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Handbook' and 'Standards Monthly Additions'.

This Indian Standard has been developed from Doc: No. ET 07 (3507)

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones: 323 01 31, 323 33 75, 323 94 02

Telegrams: Manaksanstha
(Common to all offices)

Regional Offices:		Telephone
Central	: Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	323 76 17, 323 38 41
Eastern	: 1/14 C.I.T. Scheme VII M, V.I.P. Road, Maniktola CALCUTTA 700054	337 84 99, 337 85 61 337 86 26, 337 91 20
Northern	: SCO 335-336, Sector 34-A, CHANDIGARH 160022	60 38 43 60 20 25
Southern	: C.I.T. Campus, IV Cross Road, CHENNAI 600113	235 02 16, 235 04 42 235 15 19, 235 23 15
Western	: Manakalaya, E9 MIDC, Marol, Andheri (East) MUMBAI 400093	832 92 95, 832 78 58 832 78 91, 832 78 92
Branches	: AHMADABAD. BANGALORE. BHOPAL. BHUBANESHWAR. COIMBATORE. FARIDABAD. GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR. KANPUR. LUCKNOW. NAGPUR. PATNA. PUNE. THIRUVANANTHAPURAM.	

Printed by Reprography Unit, BIS, New Delhi